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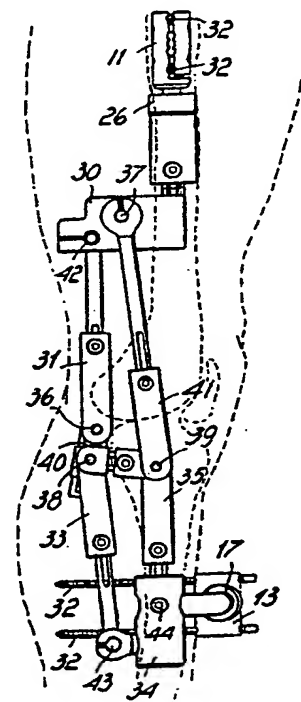
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: <b>PCT/EP87/00625</b> (22) International Filing Date: <b>22 October 1987 (22.10.87)</b> (31) Priority Application Number: <b>22229 A/86</b> (32) Priority Date: <b>4 November 1986 (04.11.86)</b> (33) Priority Country: <b>IT</b> (71) Applicant (for all designated States except US): <b>PROM-EDA S.P.A. [IT/IT]; Via Galvani, 1/1, I-20090 Trezzano Sul Naviglio (IT).</b> (72) Inventor; and (75) Inventor/Applicant (for US only) : <b>DANIELI, Guido [IT/IT]; Viale Filippetti, 28/A, I-20122 Milano (IT).</b> (74) Agent: <b>GARRONE, Fernando; Internazionale Brevetti srl, Via Brentano, 2, I-20121 Milano (IT).</b></p>		<p>(81) Designated States: <b>AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.</b></p> <p><b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>

(54) Title: **ARTICULATION SUPPORT DEVICE**

(57) Abstract

Device for the support of human articulations, comprising a first element (10) which supports a first member (11) adapted to be connected to the first bone of the articulation, and a second element (12) supporting a second member (13) adapted to be connected to the second bone of the articulation. The first element supports a first hinge (14) and a second hinge (15), and the second element supports a third hinge (16) and a fourth hinge (17). The first hinge and the third hinge are connected by a first connecting rod (18), and the second hinge and the fourth hinge are connected by a second connecting rod (19). The device can be applied to damaged articulations, allowing and guiding the natural motion of the articulation until complete healing is achieved.



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## ARTICULATION SUPPORT DEVICE

Technical Field

The present invention relates to a device for the support of human articulations, adapted for therapeutic use for damaged articulations and/or bone structures.

Background art

Supporting structures for articulations are known, in particular for the articulation of the knee, which employ one hinge or two coaxial hinges to support the two parts of the leg which articulate at the knee: the femur and the tibia. However, in practice it has been observed that such known structures do not produce useful effects since they are unable to follow the natural movement of the tibia with respect to the femur, and therefore cause, in the knee, during the flexing of the leg, additional stresses which far from facilitating the healing process determine instead further damage.

DISCLOSURE OF THE INVENTION

15 The aim of the present invention is to provide a device for the support of human articulations which allows to follow the natural movement of the articulation without producing extraneous stresses.

20 An object of the invention is to provide a device having modest weight and dimensions which can be applied to the articulation and transported easily.

Another object of the invention is to provide an adjustable device, which can be adapted to the particular configuration of the articulation of each single individual.

An important object of the invention is to allow the reconstruction of the cartilage tissues of the articulation.

This aim, as well as these and other objects, are achieved by the device for the support of human articulations according to the invention, which comprises a first element which supports a first member adapted to be connected to the first bone of the articulation, a second element supporting a second member adapted to be connected to the second bone of said articulation and is characterized in that said first element supports a first hinge and a second hinge, and in that said second element supports a third hinge and a fourth hinge, said first hinge and said third hinge being connected by a first connecting rod, said second hinge and said fourth hinge being connected by a second connecting rod, the axes of rotation of said first, second, third and fourth hinges being parallel to one another.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the invention will become apparent from the description of a preferred, but not exclusive, embodiment of the device, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a lateral view of the device according to the invention;

figure 2 is a lateral view, in partial cross section, of an enlarged detail of the device of figure 1;

figure 3 is a lateral view of a second embodiment of the device according to the invention; and

figure 4 is a lateral view, in partial cross section, of the device of figure 3.

#### WAYS OF CARRYING OUT THE INVENTION

5 With reference to figure 1, the device according to the invention is illustrated in its application to the articulation of a human knee. The device comprises a first element 10, which supports a first member 11. The first member 11 is adapted to be connected to the first bone of  
10 the articulation, to the femur in the particular case illustrated. The connection between the first member 1 and the femur is obtained by means of screws. A second element 12 supports a second member 13. The second member 13 is adapted to be connected to the second bone of the  
15 articulation, to the tibia in the particular case illustrated. The connection between the second member 13 and the tibia is achieved by means of screws. The first element 10 supports a first hinge 14 and a second hinge 15. The second element 12 supports a third hinge 16 and a fourth  
20 hinge 17. The first hinge 14 and the third hinge 16 are connected by a first connecting rod 18. The second hinge 15 and the fourth hinge 17 are connected by a second connecting rod 19. The axes of rotation of the first, second, third and fourth hinges are parallel to one another and are  
25 substantially perpendicular to the plane of motion, that is to say to the plane which contains the femur and the tibia

in all the positions of their relative motion.

According to a preferred embodiment of the device according to the invention, the positions of the first hinge 14 and of the second hinge 15 on the first element 10 are each adjustable with two degrees of freedom of adjustment, in a plane perpendicular to the axes of rotation. Similarly, the positions of the third hinge 16 and of the fourth hinge 17 on the second element 12 are each adjustable with two degrees of freedom of adjustment in a plane perpendicular to 10 said axes of rotation.

With reference to figure 2, a hinge 20, which represents any of the hinges 14, 15, 16 and 17, is supported in the first element 10 or in the second element 11 by means of first adjustment means constituted, for example, by the 15 pair of screws 21 and 22, which allow the setting of the first degree of freedom of adjustment. Said hinge 20 is furthermore supported by means of second adjustment means, constituted, for example, by the pair of screws 23 and 24, which allow the setting of the second degree of freedom of 20 adjustment.

With reference to figure 1, the length of the second connecting rod 19 is adjustable, for example by means of a telescopic body 25 which can be locked in any desired position by means of a locking screw. The first element 10 25 is connected to the first member 11 by means of, for example, a spherical hinge 26, which can be released or

locked in any position during the step of application of the device to the articulation. The second element 12 is connected to the second member 13 by means of a spherical hinge 27, which can be locked or released in any position 5 during the application of the device to the articulation. The spherical hinges 26 and 27 allow to adapt the device to the particular and, to a certain extent, casual positioning of the screws in the femur and in the tibia.

With reference to figures 3 and 4, an embodiment of the 10 invention, particularly preferred from the point of view of the mechanical assembly of the various parts, is illustrated; the device according to the invention comprises a first element 30, 37, which supports a first member 11. The first member 11 is adapted to be connected to the first 15 bone of the articulation, to the femur in the particular case illustrated. The connection between the first member 11 and the femur is achieved by means of screws 32. A second element 33, 34, 35 supports a second member 13. The second member 13 is adapted to be connected to the second bone of 20 the articulation, to the tibia in the particular case illustrated. The connection between the second member 13 and the tibia is achieved by means of screws 32. The first element 30, 31 supports a first hinge 36 and a second hinge 37. The second element 33, 34, 35 supports a third hinge 38 25 and a fourth hinge 39. The first hinge 36 and the third hinge 38 are connected by a first connecting rod 40. The

second hinge 37 and the fourth hinge 39 are connected by a second connecting rod 41. The axes of rotation of the first, second, third and fourth hinges are parallel to one another and are substantially perpendicular to the plane of motion, that is to say to the plane which contains the femur and the tibia in all the positions of their relative motion.

The first element 30, 31 is formed by a supporting body 30 which supports the first member 11, and by a telescopic arm 31 which is connected to the supporting body 30 by means of a hinge 42 which can be locked and released.

The second element 33, 34, 35 is formed by a supporting body 34 which supports the second member 13 and a telescopic arm 33 which is connected to the supporting body 34 by means of a hinge 43 which can be locked and released.

Naturally the release and locking of the hinges 42 and 43 occurs only during the step of adjustment of the device according to the invention, while during the subsequent operation the hinges 42 and 43 are always locked.

Similarly, after the initial adjustment, the adjustable connecting rods 40 and 41 always operate only with their preset length, which must no longer be modified during operation.

The same is true for the arms 31, 33, 35, which are kept at their preset length after the initial adjustment.

The arm 31 supports the first hinge 36, the arm 33 supports the third hinge 38 and the arm 35 supports the



fourth hinge 39.

The supporting body 34 can be moved during the initial preadjustment with respect to the member 13 and can thus be fixed by acting on the nut 44.

5     The present invention is susceptible to numerous modifications and variations, all of which are within the scope of the same inventive concept; in particular the means for the adjustment of the position of the hinges can be provided with a great number of solutions which are  
10 mechanically different but perfectly equivalent with regard to the present invention.

CLAIMS

1        1. Device for the support of human articulations,  
2 comprising a first element which supports a first member  
3 adapted to be connected to the first bone of the  
4 articulation, a second element supporting a second member  
5 adapted to be connected to the second bone of said  
6 articulation and characterized in that said first element  
7 supports a first hinge and a second hinge, and in that said  
8 second element supports a third hinge and a fourth hinge,  
9 said first hinge and said third hinge being connected by a  
10 first connecting rod, said second hinge and said fourth  
11 hinge being connected by a second connecting rod.

1        2. Device according to claim 1, characterized in that  
2 the axes of rotation of said first, second, third and fourth  
3 hinges are parallel to one another.

1        3. Device according to claim 1, characterized in that  
2 the positions of said first hinge and of said second hinge  
3 on said first element are each adjustable with two degrees  
4 of freedom in a plane perpendicular to said axes of  
5 rotation.

1        4. Device according to claim 1, characterized in that  
2 the positions of said third hinge and of said fourth hinge  
3 on said second element are each adjustable with two degrees  
4 of freedom in a plane perpendicular to said axes of  
5 rotation.

1        5. Device according to claim 1, characterized in that  
2 the length of said second connecting rod is adjustable.

1        6. Device according to claim 1, characterized in that  
2 said first element is connected to said first member by  
3 means of a spherical hinge which can be locked or released  
4 in any position.

1        7. Device according to claim 1, characterized in that  
2 said second element is connected to said second member by  
3 means of a spherical hinge which can be locked or released  
4 in any position.

1        8. Device according to claim 1, characterized in that  
2 said first element is formed by a supporting body which  
3 supports said first member, and by a telescopic arm  
4 connected to said supporting body by means of a lockable and  
5 unlockable hinge.

1        9. Device according to claim 1, characterized in that  
2 said second element is formed by a supporting body which  
3 supports said second member, and by a telescopic arm  
4 connected to said supporting body by means of a lockable and  
5 unlockable hinge.

1        10. Device for the support of articulations, according  
2 to what is described and illustrated.

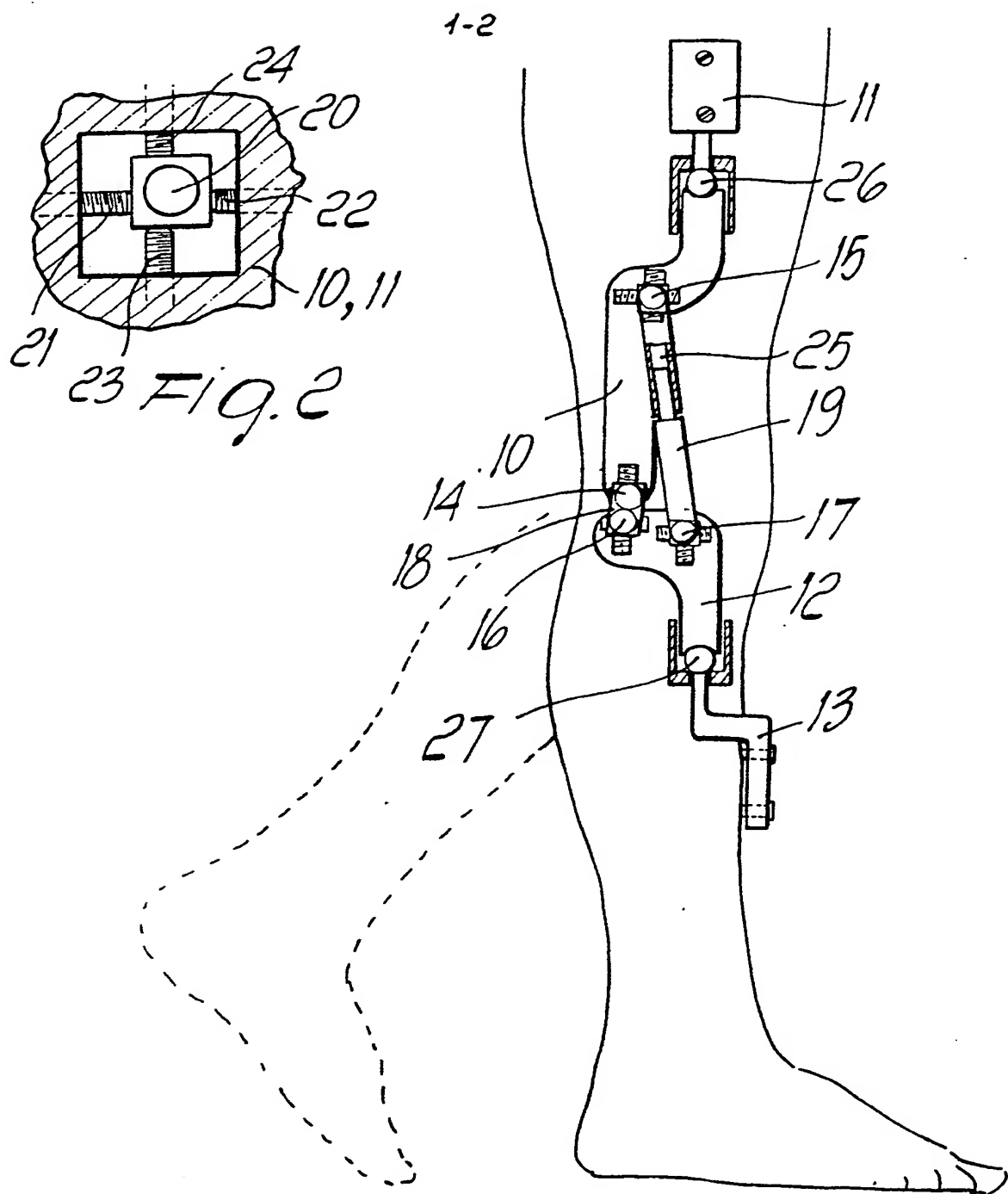
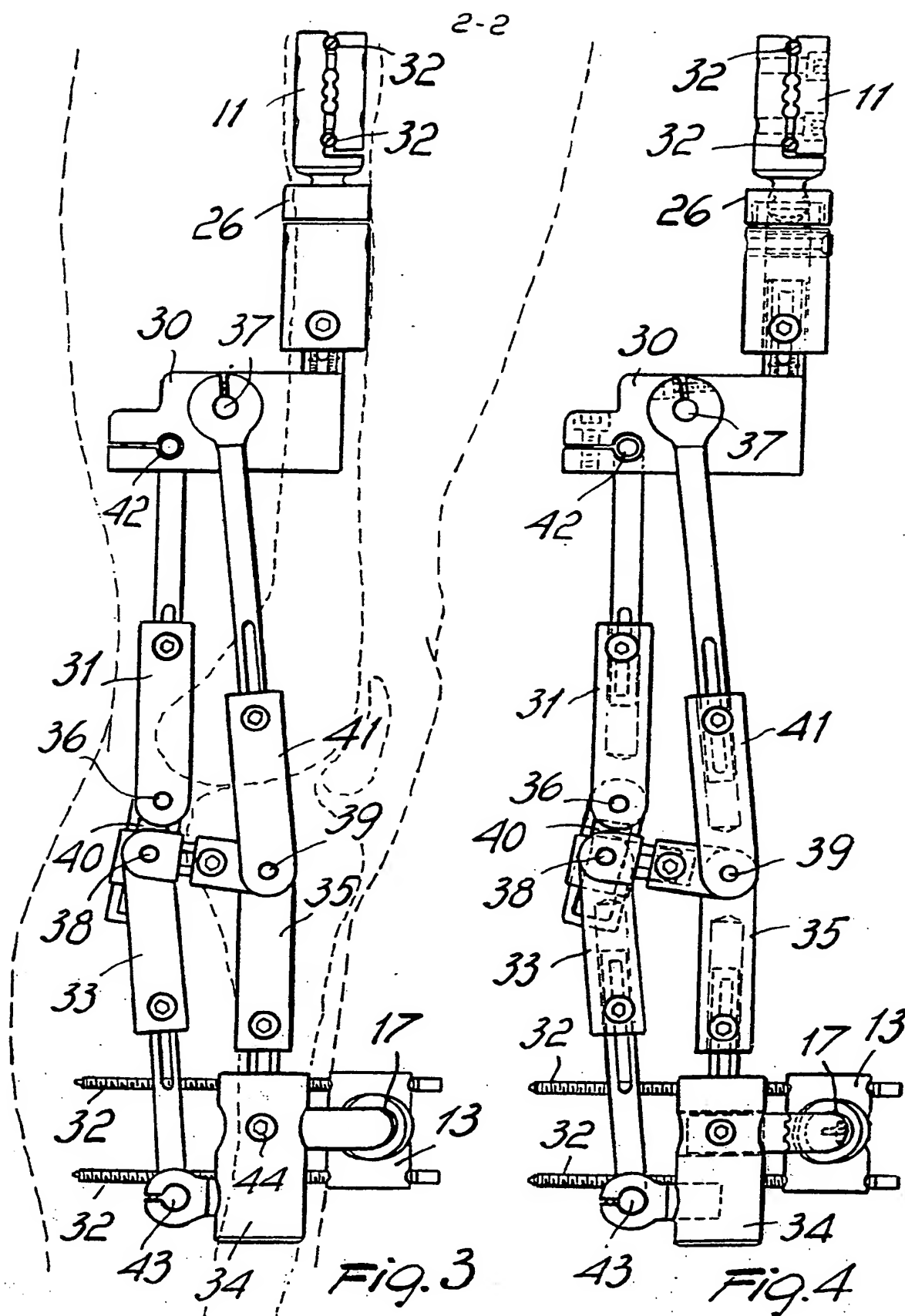


Fig. 1



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 87/00625

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC IPC <sup>4</sup> :            A 61 F 5/01; A 61 B 17/60																							
<b>II. FIELDS SEARCHED</b> <div style="text-align: right; font-size: small;">Minimum Documentation Searched <sup>7</sup></div> <table style="width: 100%; border: none;"> <tr> <td style="width: 30%; border: none;">Classification System</td> <td style="border: none;">Classification Symbols</td> </tr> <tr> <td style="border: none; padding: 5px;">IPC<sup>4</sup></td> <td style="border: none; padding: 5px;">A 61 F; A 61 B</td> </tr> </table> <div style="text-align: center; font-size: x-small; margin-top: 5px;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup></div>			Classification System	Classification Symbols	IPC <sup>4</sup>	A 61 F; A 61 B																	
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<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b> <table style="width: 100%; border: none;"> <tr> <td style="width: 10%; border: none; font-size: x-small;">Category <sup>10</sup></td> <td style="width: 70%; border: none; font-size: x-small;">Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></td> <td style="width: 20%; border: none; font-size: x-small;">Relevant to Claim No. <sup>13</sup></td> </tr> <tr> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="border: none; padding: 5px;">US, A, 4523585 (LAMB et al.) 18 June 1985 see figures 1-4; column 1, lines 60-67; column 3, lines 1-6, 13-18 --</td> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">1,2</td> </tr> <tr> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: none; padding: 5px;">FR, A, 2231356 (HANGER &amp; CO. LTD) 27 December 1974 see figures 1,2; page 1, lines 1-10, 25-38; page 2, lines 25-37 --</td> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">1,2</td> </tr> <tr> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: none; padding: 5px;">FR, A, 2279374 (TSENTRALNY et al.) 20 February 1976 see figures 1,5; page 8, lines 13-29 --</td> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">3,4</td> </tr> <tr> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: none; padding: 5px;">FR, A, 2552660 (DELBOS) 5 April 1985 see figure 1; page 3, lines 1-15 --</td> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">5</td> </tr> <tr> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: none; padding: 5px;">US, A, 4256097 (WILLIS) 17 March 1981 see figures 1,2,6-9; column 3, lines 1-15; column 5, lines 35-42 --</td> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">5-7</td> </tr> <tr> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: none; padding: 5px;">US, A, 2238870 (HAYNES) 4 February 1939 see figures 1-3; page 1, right-hand column, lines 13-55</td> <td style="border: none; text-align: center; vertical-align: top; padding: 5px;">6,7</td> </tr> </table> <div style="font-size: x-small; margin-top: 5px;"> <p><sup>9</sup> Special categories of cited documents: --</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>10</sup> "A" document defining the general state of the art which is not considered to be of particular relevance</p> <p><sup>11</sup> "E" earlier document but published on or after the international filing date</p> <p><sup>12</sup> "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p><sup>13</sup> "O" document referring to an oral disclosure, use, exhibition or other means</p> <p><sup>14</sup> "P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p><sup>15</sup> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p><sup>16</sup> "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p><sup>17</sup> "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p><sup>18</sup> "A" document member of the same patent family</p> </div> </div> </div>			Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	X	US, A, 4523585 (LAMB et al.) 18 June 1985 see figures 1-4; column 1, lines 60-67; column 3, lines 1-6, 13-18 --	1,2	A	FR, A, 2231356 (HANGER & CO. LTD) 27 December 1974 see figures 1,2; page 1, lines 1-10, 25-38; page 2, lines 25-37 --	1,2	A	FR, A, 2279374 (TSENTRALNY et al.) 20 February 1976 see figures 1,5; page 8, lines 13-29 --	3,4	A	FR, A, 2552660 (DELBOS) 5 April 1985 see figure 1; page 3, lines 1-15 --	5	A	US, A, 4256097 (WILLIS) 17 March 1981 see figures 1,2,6-9; column 3, lines 1-15; column 5, lines 35-42 --	5-7	A	US, A, 2238870 (HAYNES) 4 February 1939 see figures 1-3; page 1, right-hand column, lines 13-55	6,7
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<b>IV. CERTIFICATION</b> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; font-size: x-small;">Date of the Actual Completion of the International Search</td> <td style="width: 50%; border: none; font-size: x-small;">Date of Mailing of this International Search Report</td> </tr> <tr> <td style="border: none; text-align: center; padding: 5px;">27th January 1988</td> <td style="border: none; text-align: center; padding: 5px;">16 MAR 1988</td> </tr> <tr> <td style="border: none; font-size: x-small;">International Searching Authority</td> <td style="border: none; font-size: x-small;">Signature of Authorized Officer</td> </tr> <tr> <td style="border: none; text-align: center; padding: 5px;">EUROPEAN PATENT OFFICE</td> <td style="border: none; text-align: center; padding: 5px;">   <b>P.C.G. VAN DER PUTTEN</b> </td> </tr> </table>			Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	27th January 1988	16 MAR 1988	International Searching Authority	Signature of Authorized Officer	EUROPEAN PATENT OFFICE	 <b>P.C.G. VAN DER PUTTEN</b>													
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# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

EP 8700625

SA 19325

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4523585	18-06-85	None	
FR-A- 2231356	27-12-74	NL-A- 7407181	03-12-74
		DE-A, C 2426079	19-12-74
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		GB-A- 1430990	07-04-76
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FR-A- 2552660	05-04-85	None	
US-A- 4256097	17-03-81	None	
US-A- 2238870		None	

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